Final Report: Characterization of the VSW Environment for UUV-N Operations

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14. ABSTRACT
A process-based, numerical, hydrodynamic model (VORTEX) was used to characterize the order-one geophysical fluid forcing that a UUV-N would be subjected to in the VSW environment at two canonical beach environments. The VORTEX model used for these simulations was developed under the ONR?s Mine Burial Program. The beach environments were selected by NAVSURFWARCEN CSS Panama City and are representative of two of the five primary coastal types that characterize global coastal diversity.

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Characterization of the VSW Environment for UUV-N Operations

[1] Gerald D' Spain and Scott A. Jenkins

OBJECTIVE*:* A process-based, numerical, hydrodynamic model (VORTEX) was used to characterize the order-one geophysical fluid forcing that a UUV-N would be subjected to in the VSW environment at two canonical beach environments. The VORTEX model used for these simulations was developed under the ONR's Mine Burial Program [1], [11], [21]. The beach environments were selected by NAVSURFWARCEN CSS Panama City and are representative of two of the five primary coastal types that characterize global coastal diversity.

APPROACH: We utilize the top end architecture of the *Vortex Lattice (VORTEX) Mine Scour and Burial Model* to characterize the depth variation and geophysical fluid forcing during UUV-N operations in the VSW zone. The computations utilize the farfield processes algorithms of the model. Bathymetry inputs to the model were provided in 3 arc-second resolution by the Tactical Charting Branch, Naval Oceanogarphic Office, Code NP 431. Nearshore bathymetry associated with seasonal shorerise profile variability was specified by the thermodynamic equilibrium profile algorithms due to Jenkins and Inman 2006. Wave inputs to the model were provided by DIOPS of FNMOC at NAVPACMETOCEAN.

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RESULTS: Based on these inputs, the model produced two distinct sets of VSW characterization for the fluid forcing on a UUV-N, namely: a long wave high-energy environment; and a short wave low-energy environment. Results for the high energy environment are summarized in Table 1. The shorerise bottom profile is a type-b cycloid

Table 1: Velocity Statistics Along the Cross-Shore Profile of X-Beach

Depth, m	Maximum offshore velocity, cm/sec	Maximum onshore velocity, cm/sec	rms-velocity, cm/sec	Mean drift, cm/sec
3.0	373.9	-411.9	51.3	-8.57
5.0	127.6	-137.6	24.8	-0.43
8.0	71.43	-81.2	18.3	-2.11
9.0	50.36	-71.76	16.4	-2.96
10.0	56.1	-99.1	15.1	-2.94
11.0	57.2	-67.0	14.1	-2.76
13.0	45.6	-70.3	13.1	-2.77
15.0	36.8	-46.6	11.9	-2.19

comprised of coarse quartz sediment. The amplitudes of the cross shore oscillatory currents have a maximum of 47 cm/sec and root mean squared (rms) values of 12 cm/sec in the outer portion of the VSW zone, increasing to maximums of 411 cm/sec with rms values of 51 cm/sec in the inner portion of the VSW zone at the surf zone. The cross shore currents are complex periodic oscillations with periods ranging from 12 sec to 22 sec. There is also a net onshore drift superimposed on the oscillatory motion that ranges from 2 cm/sec in the outer VSW zone, increasing to 8.5 cm/sec in the inner portions near the surfzone.

Results for the low energy environment are summarized in Table 2. This site is characterized by a type-a cycloid shorerise profile comprised of a mixture of fine to coarse quartz and carbonate sediments in a layered stratigraphy. The maximum amplitudes of the cross shore

Table 2: Velocity Statistics Along the Cross-Shore Profile of Y-Beach

Depth, m	Maximum offshore velocity, cm/sec	Maximum onshore velocity, cm/sec	rms-velocity, cm/sec	Mean drift, cm/sec
2.0	64.2	-108.5	22.49	-5.48
3.0	69.9	-94.9	19.5	-3.46
4.0	43.3	-59.9	13.8	-2.82
5.0	26.9	-30.7	9.29	-2.11
6.0	20.9	-20.4	6.93	-1.63
7.0	23.48	-24.98	7.14	-1.46
8.0	14.1	-14.7	5.35	-0.68
9.0	12.4	-13.1	5.25	-0.04

oscillatory currents in the low energy environment vary from 13 cm/sec in the outer portion of the VSW zone, to 108 cm/sec in the inner portion at the surfzone. The rms values range from 5 cm/sec to 23 cm/sec between the outer and inner portions of the VSW zone. Periods of motion range from 4 sec to 10 sec in the fetch limited low energy environment.

REPORTS AND PUBLICATIONS:

S. A. Jenkins , D. L. Inman, M. D. Richardson, T. F. Wever, and J. Wasyl , 2007, "Scour and Burial Mechanics of Objects in the Nearshore*,"* *IEEE Jour Oc Eng*, vol 32, no.1, pp 50-64.

S. A. Jenkins and J. Wasyl, 2006, "Characterization of the VSW Environment for UUV-N operations" submitted to Naval Surface Warfare Center, Panama City, FL., 33 pp.

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